ods as described above. In one example, the instructions or software include machine code that is directly executed by the processor or computer, such as machine code produced by a compiler. In another example, the instructions or software include higher-level code that is executed by the processor or computer using an interpreter. Programmers of ordinary skill in the art, after gaining a thorough understanding of the present disclosure, can readily write the instructions or software based on the block diagrams and the flow charts illustrated in the drawings and the corresponding descriptions in the specification, which disclose algorithms for performing the operations performed by the hardware components and the methods as described above.

[0172] The instructions or software to control a processor or computer to implement the hardware components and perform the methods as described above, and any associated data, data files, and data structures, are recorded, stored, or fixed in or on one or more non-transitory computer-readable storage media. Examples of a non-transitory computer-readable storage medium include read-only memory (ROM), random-access memory (RAM), flash memory, CD-ROMs, CD-Rs, CD+Rs, CD-RWs, CD+RWs, DVD-ROMs, DVD-Rs, DVD+Rs, DVD-RWs, DVD+RWs, DVD-RAMs, BD-ROMs, BD-Rs, BD-R LTHs, BD-REs, magnetic tapes, floppy disks, magneto-optical data storage devices, optical data storage devices, hard disks, solid-state disks, and any device known to one of ordinary skill in the art that is capable of storing the instructions or software and any associated data, data files, and data structures in a non-transitory manner and providing the instructions or software and any associated data, data files, and data structures to a processor or computer so that the processor or computer can execute the instructions. In one example, the instructions or software and any associated data, data files, and data structures are distributed over network-coupled computer systems so that the instructions and software and any associated data, data files, and data structures are stored, accessed, and executed in a distributed fashion by the processor or computer.

[0173] Unless indicated otherwise, a statement that a first layer or object is "on" a second layer or object or a substrate is to be interpreted as covering both a case where the first layer directly contacts the second layer or the substrate, and a case where one or more other layers are disposed between the first layer and the second layer or the substrate.

[0174] Words describing relative spatial relationships, such as "below", "beneath", "under", "lower", "bottom", "above", "over", "upper", "top", "left", and "right", may be used to conveniently describe spatial relationships of one device, objects, or elements with other devices, objects, or elements. Such words are to be interpreted as encompassing a space oriented as illustrated in the drawings, and in other orientations in use or operation. For example, a space includes a second layer disposed above a first layer based on the orientation of the first space or the scene illustrated in the drawings also encompasses the scene or first space when flipped upside down in use or operation.

[0175] While this disclosure includes specific examples, it will be apparent to one of ordinary skill in the art that various changes in form and details may be made in these examples without departing from the spirit and scope of the claims and their equivalents. The examples described herein are to be considered in a descriptive sense only, and not for purposes of limitation. Descriptions of features or aspects in each example are to be considered as being applicable to similar features or aspects in other examples. Suitable results may be achieved if the described techniques are performed in a different order, and/or if components in a described system, architecture, device, or circuit are combined in a different manner, and/or replaced or supplemented by other components or their equivalents. Therefore, the scope of the disclosure is defined not by the detailed description, but by the claims and their equivalents, and all variations within the scope of the claims and their equivalents are to be construed as being included in the disclosure.

What is claimed is:

1. A method of displaying caustics, the method comprising:

determining intersection positions at which rays emitted from a light source pass through particles of a first object and meet a second object;

applying caustic textures to the intersection positions; and

rendering the first object using a caustic map based on a result of the applying caustic textures to the intersection positions.

2. The method of claim **1**, wherein the determining of the intersection positions comprises tracing a path of the rays and calculating the intersection positions for each of the particles.

3. The method of claim **1**, further comprising receiving at least one of information about a position of the light source, a depth map pre-rendered from the position of the light source, positions of the particles, and a surface normal vector of the first object,

wherein the determining of the intersection positions comprises calculating the intersection positions for each of the particles based on the received information.

4. The method of claim **1**, wherein the determining of the intersection positions comprises calculating intersection positions for particles directly visible from the light source among the particles.

5. The method of claim **4**, wherein the determining of the intersection positions for the particles directly visible from the light source comprises determining the particles directly visible from the light source among the particles.

6. The method of claim **5**, wherein the determining of the particles directly visible from the light source comprises determining the particles directly visible from the light source among the particles, based on first depth information of a depth map pre-rendered from a position of the light source.

7. The method of claim **6**, wherein the determining of the particles directly visible from the light source comprises determining whether the rays directly reach the particles based on a result of a comparison between the first depth information and second depth information of the particles, the second depth information acquired by converting positions of the particles viewed from a viewpoint to a space of a virtual camera in the position of the light source.

8. The method of claim **1**, wherein the applying of the caustic textures to the intersection positions comprises:

marking vertices corresponding to the intersection positions; and

applying the caustic textures to the vertices.

9. The method of claim **8**, wherein the applying of the caustic textures to the vertices comprises:

selecting the caustic textures based on at least one of a fluid surface curvature of each of the particles corre-